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14. ABSTRACT
The complex interaction of surface waves with coastal inlet structures and inlet morphology is of significant importance to navigation channel operation and maintenance. Wave data in the vicinity of coastal inlets are limited. Where field wave data exist, the temporal and spatial coverage is inadequate to resolve the evolution of wave refraction and diffraction patterns of the free surface. To address the challenge of quantifying variations in wave direction in the coastal system, the US Army Engineer Research and Development Center applied video techniques in a physical model to obtain spatially and temporally dense measurements of wave direction. These measures are required to advance understanding of first-order inlet processes and to use the measurements in numerical simulation model development and verification. In this paper, detailed results are discussed for random and a single monochromatic wave experiments conducted for evaluation of wave diffraction patterns influenced by coastal structures and coastal inlet bathymetry.

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Measurement of Physical Model Wave Diffraction Patterns Using Video

William R. Curtis[1], Kent Hathaway[2], William C. Seabergh[3] and Todd K. Holland[4]

The complex interaction of surface waves with coastal inlet structures and inlet morphology is of significant importance to navigation channel operation and maintenance. Wave data in the vicinity of coastal inlets are limited. Where field wave data exist, the temporal and spatial coverage is inadequate to resolve the evolution of wave refraction and diffraction patterns of the free surface. To address the challenge of quantifying variations in wave direction in the coastal system, the US Army Engineer Research and Development Center applied video techniques in a physical model to obtain spatially and temporally dense measurements of wave direction. These measures are required to advance understanding of first-order inlet processes and to use the measurements in numerical simulation model development and verification. In this paper, detailed results are discussed for random and a single monochromatic wave experiments conducted for evaluation of wave diffraction patterns influenced by coastal structures and coastal inlet bathymetry.

The video system consists of ground-controlled camera stations mounted at vantage points above the free surface of the physical model. The close range of the camera stations from the area of interest (<10 m), allows for a horizontal spatial resolution on the order of 1 cm. As many as six-camera stations are used to provide broad spatial coverage of the physical model's coastal processes. Video data are collected at a rate of 30 Hz and pixel intensity time series are digitized at locations of interest within the physical model. Pixel array data are then processed using spectral analysis methods to determine variance

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and directional spectral estimates. These *virtual* wave gage arrays may be located anywhere in a camera's field of view. Figure 1 demonstrates the utility of the system, as measurement of peak wave direction from a single camera view is indicated at 305 locations in the diffraction zone of an idealized coastal inlet.

Preliminary comparison of video-derived frequency-directional spectra with co-located acoustic doppler velocimetry (ADV) measurements indicates a high degree of accuracy. As shown in Figure 2, *in situ* and remotely sensed variance spectra have a similar shape over the frequency bands of interest and spectral peaks coincide. Near the spectral peak, wave directions are typically within 5° of the ADV measurements.

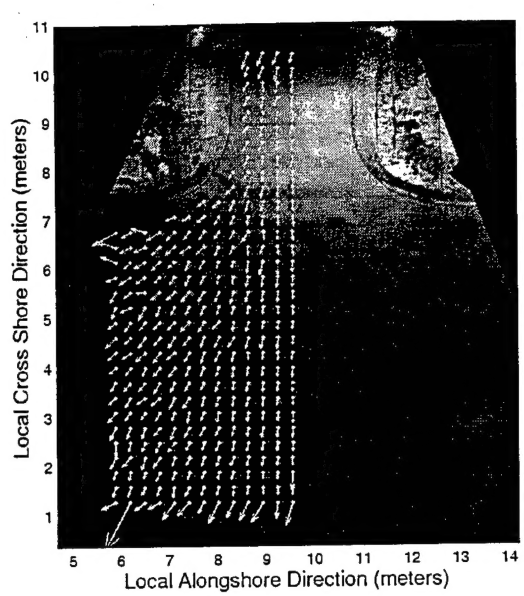

Figure 1 Video-derived Peak wave direction vectors superimposed on rectified frame collected during a random wave test. Vectors scaled by wave celerity.

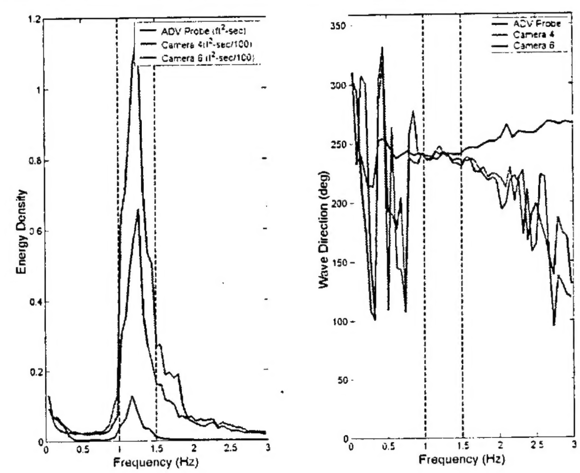

Figure 2 Co-located measurements from *in situ* ADV probe and two camera stations for a random wave test case with f_{peak} = 1.25 sec. Dashed lines represent simulated high and low wave frequency content.

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